



**TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.**

# **Bridging Team Efforts Supporting Current & Future Forces**

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The purpose of this presentation is to provide an overview of the TARDEC Bridging Team's efforts in the research and evaluation of composite bridging technology.

## Mission Statement

**To provide sound engineering support and technological advancements in military bridging systems to our customers and to be recognized as acquisition specialists and the technology leaders for future bridging systems.**

- IPT/Matrix Support to PM Bridging, PM CE/MHE PM HBCT, and PSID
  - Market Research
  - Performance Specifications
  - Requirements and Acquisition Documentation
  - Inspection Of Equipment
  - Test Reports/Planning/Monitoring
  - Procurement Work Directives (PWD) & 339's
- Areas of Technical Expertise
  - Simulation & Structural Strength Testing
  - Finite Element Modeling & Analysis
  - Fatigue Analysis
  - Military Load Classification
- Support for Emerging Technology
  - Army representative for STANAG 2010 & 2021
  - Army representative for Trilateral Design & Test Code
  - Data Exchange Agreements (DEA's)
  - Information Exchange Agreements (IEA's)



# US Army Materiel Command (USAMC)



US Army Tank-  
Automotive and  
Armaments Command  
(USA TACOM)

US Army Research,  
Development and  
Engineer Command  
(USA RDECOM)

AFSC, JMC, AMCOM,  
CECOM, CMA,  
USASAC, PM SANG

AMSAA, ARL, ARDEC, CERDEC,  
ECBC

Tank Automotive RDEC  
(TARDEC)

NSC, S&TTC, RDECOM Acq C

Engineering Business Group  
(EBG)

Product Development Business Group  
(PDBG)

Research Business Group  
(RBG)

Force Projection Technology  
(FPT)

Logistics Equipment  
Group

Maneuver Support  
Equipment

Assured Mobility  
Systems

Combat  
Engineering  
Team

Bridging Team

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# Systems Overview

## *Support Bridging*



Standard Ribbon Bridge bays in Raft configuration  
Bridge Erection Boats provide raft propulsion



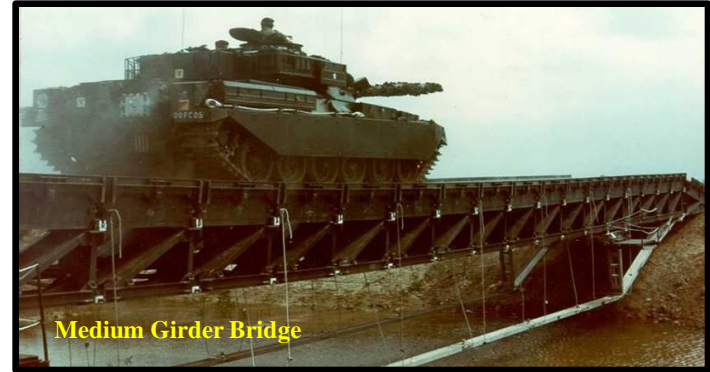
Standard Ribbon Bridge bays in Bridge configuration  
Bridge Erection Boats provide temporary anchorage

- The Multi-Role Bridge Company Equipment:
  - Common Bridge Transporter, Improved Boat Cradle & Bridge Adapter, Pallet, M1077 Pallet, Palletized Load System Trailer, Dry Support Bridge, Improved Ribbon Bridge/Standard Ribbon Bridge, Bridge Erection Boat
  - Objective is 23 full companies and one training company





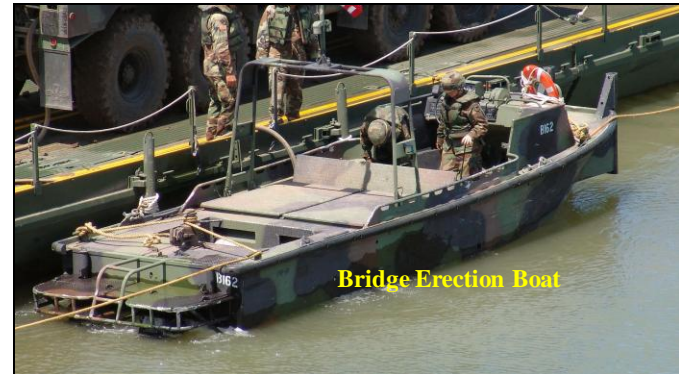
Dry Support Bridge



Medium Girder Bridge



Improved Ribbon Bridge



Bridge Erection Boat



Line Of Communication Bridge



Bailey Bridge



# Common Bridge Transport System



- Description: The CBTS is a grouping of 5 components:
  - HEMTT Common Bridge Transporter (CBT): designed to lift and transport all bridging flat racks.
  - M1077 Flat rack: designed to carry bridge sections
  - Improved Boat Cradle (IBC): designed to carry the BEB.
  - Bridge Adapter Pallet (BAP): designed to carry IRB sections.
  - Palletized Load System Trailers (PLST): to increase haul capacity.
- Current Status:
  - Production & Deployment
- Bridge Team Lead Engineer:
  - Jesse Knapp, DSN 786-8526, [jesse.knapp2@us.army.mil](mailto:jesse.knapp2@us.army.mil)

# Systems Overview

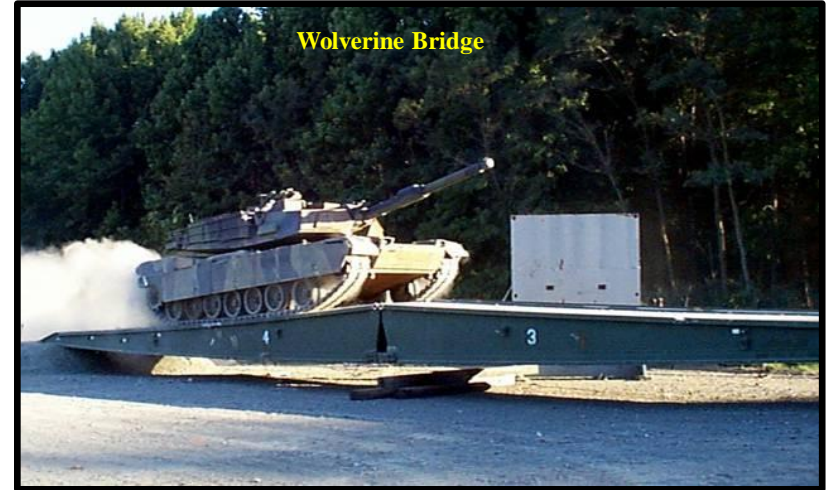
## *Assault Bridging*



Armored Vehicle Launched Bridge



Wolverine Bridge



Joint Assault Bridge



Rapidly Emplaced Bridge System

# Assault Breacher Vehicle



- Description:
  - Full tracked combat engineer vehicle for the MAGTF & Army HBCT to breach minefields & complex obstacles and provide in-stride breaching capability to maneuver forces.
- Specs:
  - M1A1 Abrams tank hull
  - 2 Mk 155 Linear Demolition Charge systems
  - Interchangeable Full Width Mine Plow & Combat Dozer Blade
  - 2 lane marking systems
- Manufacturer:
  - JAB designed in-house by Marine Corps Systems Command (MCSC)
  - Anniston Army Depot (ANAD) is production site
- Current Status:
  - USMC Lead with the Army as a participating DoD component as established in a signed Memorandum of Agreement.
  - First Army delivery planned 2QFY09
- Bridge Team Lead Engineer:
  - Percy Kirklin, DSN 786-7397, [percy.kirklin@us.army.mil](mailto:percy.kirklin@us.army.mil)

# R&D Overview

## *Composite Bridging Efforts*



## *Completed Technology Demonstrations*

### • Composite Army Bridge (CAB)



#### Critical Design Parameters

- Maximum Span: 12 meters
- Width: 4.01 meters
- Rating: MLC 100 (Tracked & Wheeled)
- Weight: < 6,000 kg
- Minimum Life: 5,000 crossings
- Results: 2000+ MLC70/100 in Field  
18K MLC70 Simulation Cycles

### • Modular Composite Bridge (MCB)



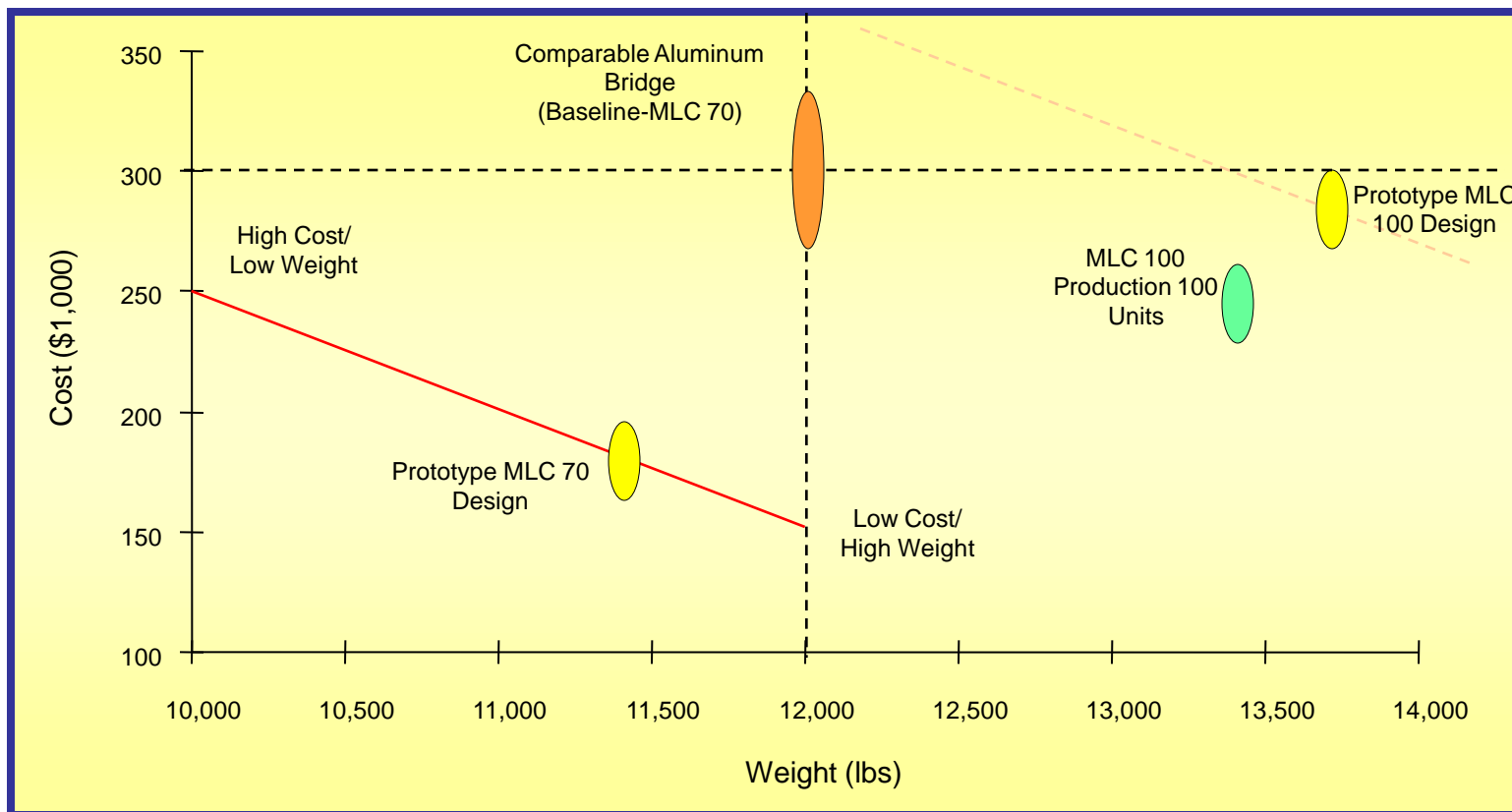
#### Critical Design Parameters

- Maximum Span: 25 meters
- Width: 4.0 meters
- Rating: MLC 65 (Tracked & Wheeled)
- Minimum Life: 5,000 crossings
- Results: 1,000 DLL Fatigue Cycles  
Fracture at 166% DLL

## LOADED HET & M1 CROSSINGS:



## TRADEOFF METRICS:



## STRUCTURAL STRENGTH TESTS:



**Test Load Summary Treadway #1**

Test	Date	Load Type	Total Load (kips)
Working Load	4/26/99	Moment	170.15
		Shear	150.12
		Shear	151.19
Overload (1.33 x W.L.)	4/27/99	Moment	228.67
		Shear	198.83
Cyclic (W.L. x 1000)	5/3/99	Moment	170.93
	5/4/99	Shear	151.18
Calc. Ultimate Load (1.5 x W.L.)	5/4/99	Moment	258.62
		Shear	223.61
Design Load (1.8 x W.L.)	5/4/99	Moment	309.24
Failure Load (2.2 x W.L.)	5/4/99	Moment	375.63



## PARTNERSHIP:



**Defense Advanced Research Projects Agency**

- Project Management.
- Technology Reinvestment Program.
- Bridge Infrastructure Renewal Program.



**US Army, Tank Automotive Research Development & Engineering Center**

- Technical Advisors for Design, Requirements & Vehicle Interface

**University of California, San Diego**

- CAB Design and Testing.
- Finite Element Analysis.

**Seemann Composites Inc.**

- Low Cost Composites Manufacturing.

**University of Delaware**

- Composite Bridge Engineering and Rehabilitation Program.
- Material Property Evaluation.
- Subscale Wear Tests



**ENTER U.S. ARMY ABERDEEN TEST CENTER**

- Full Scale Field & Wear Testing.



**US Army Engineer School**

- User Input and Feedback.

**Cold Regions Research & Engineering Laboratory**

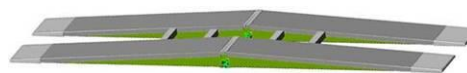
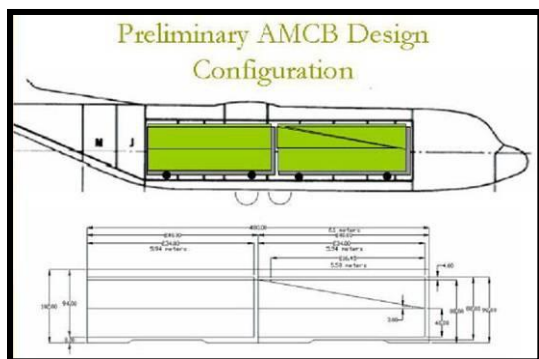
- Environmental Materials Testing
  - Cold & Hot Weather Coupon Testing



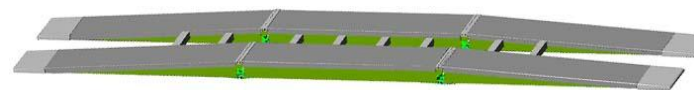


## *Advanced Modular Composite Bridge (AMCB)*

To demonstrate leap-ahead advancements in light-weight modular bridging, utilizing composite materials, in support of the next generation of gap crossing solutions for the Army's Future Force.



Gap 10 m



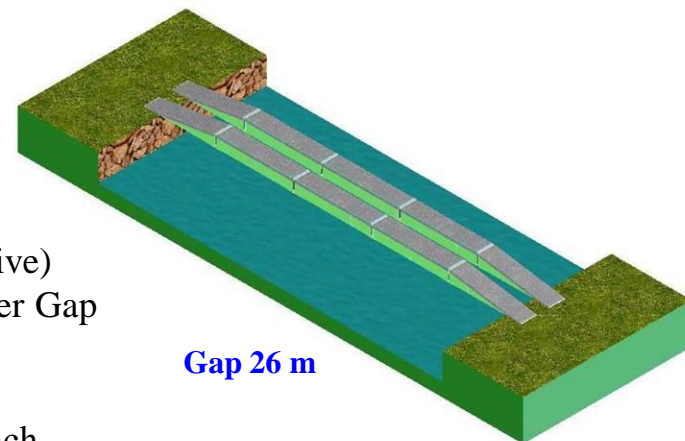
Gap 16 m



Gap 22 m

### Performance Requirements

- MLC 45\*/70 (Threshold/Objective)
- 13m/26m Gap (Threshold/Objective)
- 3.35m/4.0m Deployed Width (Threshold/Objective)
- C-130 Transportable/ Roll-On Roll-Off Capable (Threshold/Objective)
- 23,000/19,000lb Bridge Weight (Threshold/Objective) for a 26 meter Gap
- 6m Bridge Rack/Pallet Maximum Length Objective
- 4m Overpass Clearance on FTTS or PLST
- Interchangeable Modules; supporting a "Family of Bridges" approach
- Pre-Pinned/Auto-Mating Joints (Threshold/Objective)
- CH47 Helicopter Transportable in 13m/26m (Threshold/Objective) Configuration



Gap 26 m

## *Ultimate Failure Testing of Advanced modular Composite Bridge (AMCB) at UCSD*



Internal view of  
Treadway without  
Deck



View of  
Complete Treadway  
Before ultimate failure  
test at UCSD



Ramp to Center Panel Connection

3 Section all Composite Treadway  
Design Load MLC 45 Threshold/70 Objective



## *Ultimate Failure Testing of Advanced modular Composite Bridge (AMCB) at UCSD*



3 Section all Composite Treadway  
Design Load is MLC 45 Threshold/70 Objective

Failure Load 3.2 times Design Load  
357kips of Total Vertical Load

Failure occurred in the Ramp to Center Panel Tension Joint as intended.

## *GAP DEFEAT TECHNOLOGY – Composite Decks (Treadways)*

### Salient Features

- MLC 30T/65W
- Deck:
  - Length 5 m (16' 6")
  - Width 0.76 m (30")
  - Depth 0.1 m (4")
- Weight 345 Kgs. (760 lbs)
- Polymer Composite:
  - Fiberglass
  - Graphite
  - Epoxy
  - SCRIMP
- Polyurethane Wear Surface
- Proof Tested to 1.33 working Load



**Composite Treadways**



**Discussions with  
Treadways Designer**



**CBT Crossing**



**HMMWV Crossing**



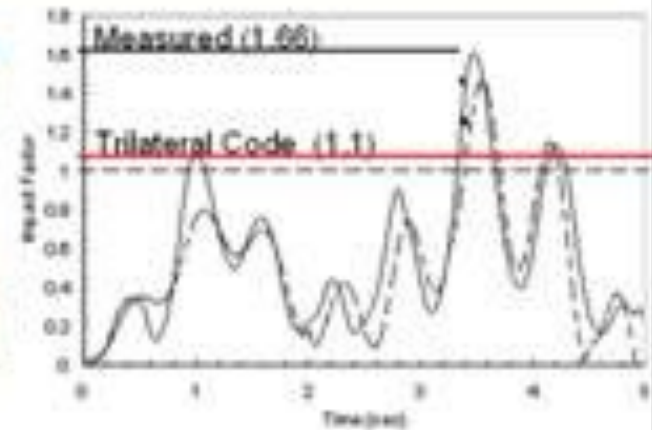
**Turretless M60 Crossing**



**M113 Crossing**  
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## *Field Testing of MLC 30 1.5-4 meter Deck/Treadway at UCSD*

### Aberdeen Deck Testing

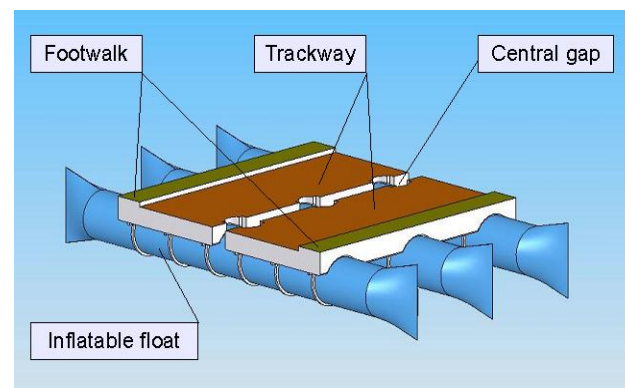
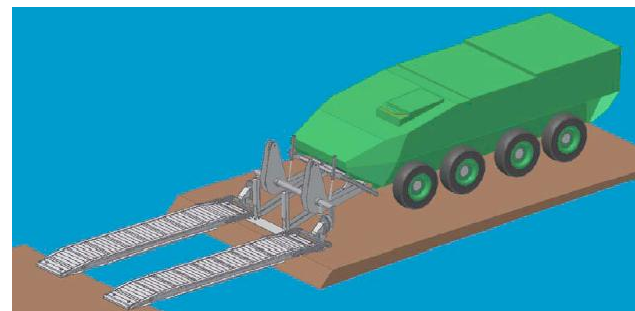


### 29 Palms Deck Testing

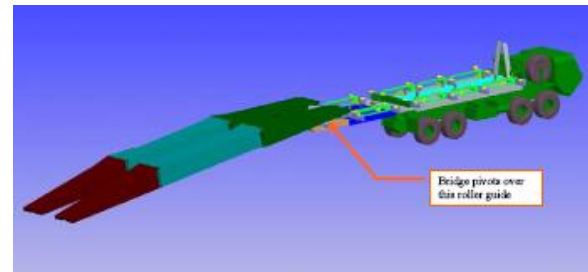




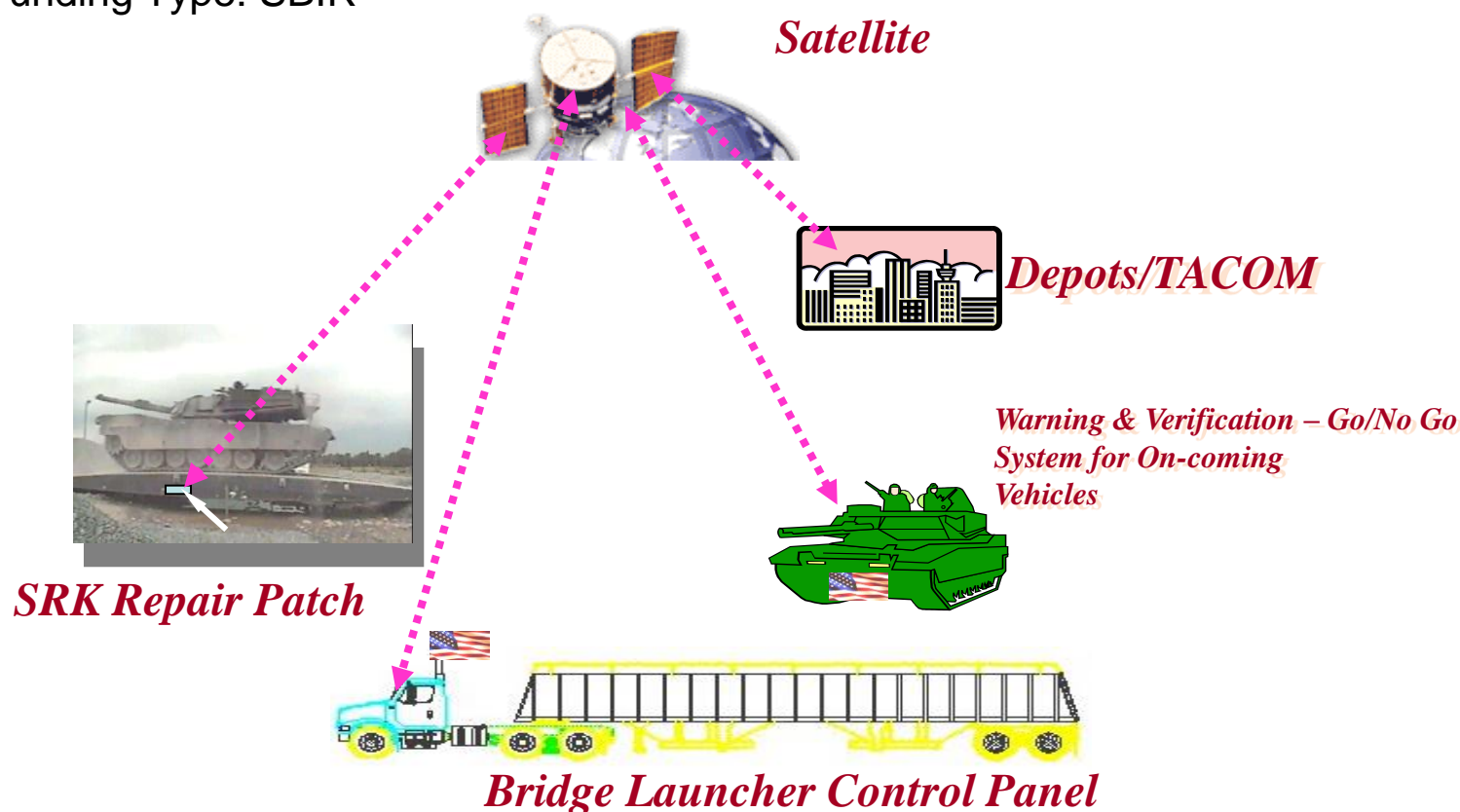
- Title: Rapidly deployable gap defeat technology (GDT) for the Future Combat System (FCS) / Future Force (FF)
  - Description: Provide a 1.5 to 4m wet/dry gap bridging technology that is MLC 30/70 (threshold/objective) capable, C-130 aircraft transportable, weigh less than 3000 lbs., can be remotely operated or autonomous, and can be integrated with future FCS vehicle platforms.
  - Funding Type: Broad Agency Announcement (cost sharing contract: 60% govt, 40% contractor), Phase I
  
- Title: Innovative Wet Gap Crossing Technologies for the Future Combat System/Future Force
  - Description: Develop an infinite wet gap spanning bridge technology that is C-130 transportable, MLC 30/65 (threshold/objective) capable, and able to be integrated with the Future Combat System vehicles.
  - Funding Type: SBIR (cost + fixed fee contract), Phase II



- Title: Assured Operational Mobility Across Gaps for the (FCS/FF)
  - Description: A flip cantilever bridge and launch technology to remotely deploy a bridge and keep the soldier out of harms way
  - Funding Type: SBIR Phase II
- Title: Gap Defeat Technology for the FCS
  - Description: Sense the gap, Remotely Inflatable Fascines to be dropped in the 1.5 – 4 meter gaps; C-130 transportable, CH47 deployable
  - Funding Type: 6.2



- Title: Repair and Health Monitoring of Composite Military Bridges
  - Description: Diagnostic/Prognostic Structural Health Monitoring of Composite Bridges and their repair, Field/Depot Repair Methodologies
  - Funding Type: SBIR



# Future Bridging Programs

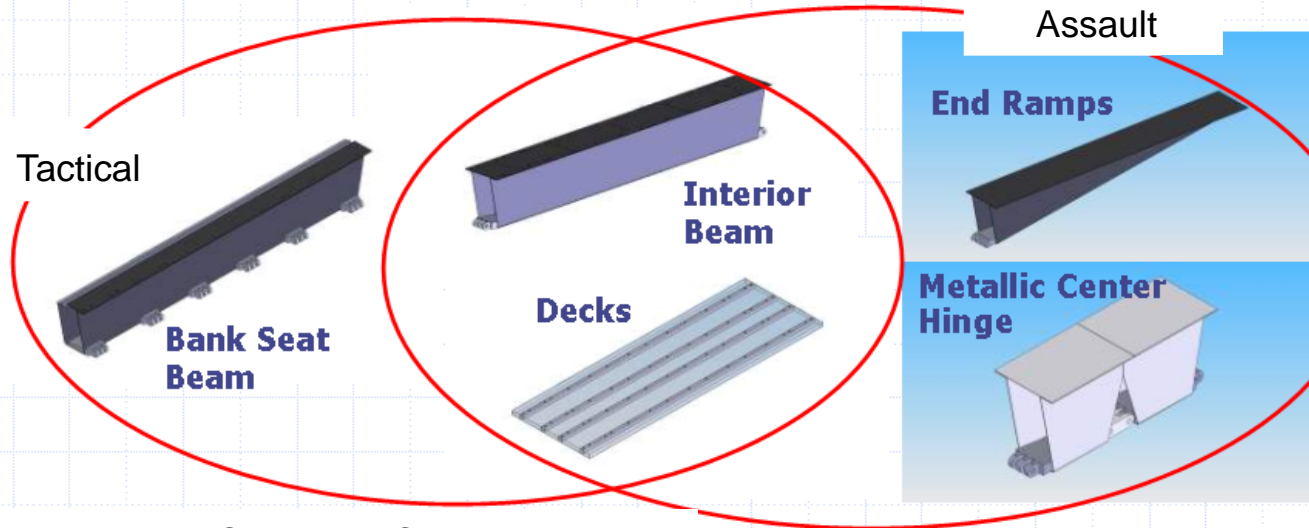


## LAGC Family of Bridges

- Short gap crossing capabilities gaps will be identified in the upcoming LAGC Capabilities Development Document (CDD). This CDD will breakdown the capabilities into three separate categories:
- **Tier 1: Dismounted - Footbridge:**
  - Soldiers on dismounted patrols are often required to cross canals. Soldiers currently have no means for safely crossing the canals short of wading across, and have requested canal crossing equipment that is Soldier-portable, easily and quickly emplaced, and recoverable after crossing to carry to the next canal to be crossed.
    - Hand emplaced
    - Fixed- length from 1 to 25 m
      - Capable of sustaining one soldier crossing at a time, approx 280 lbs ea
    - Floating- length up to 50 m, current velocity less than 6 fps
      - Capable of sustaining multiple soldier crossing at a time (5 m intervals), approx 280 lbs ea
- **Tier 2: Mounted – Short Gap:**
  - 4-8 m length
  - HUMVEE type of launch platform - light maneuverable launch/retrieve platform
  - MLC 45
  - Launch time: < 5 minutes
- **Tier 3: Mounted - Medium Gap:**
  - 13-18 m length
  - Platform: Bradley or Stryker type of platform
  - MLC 45
  - Launch time: < 5 minutes while crew is protected in platform while under fire

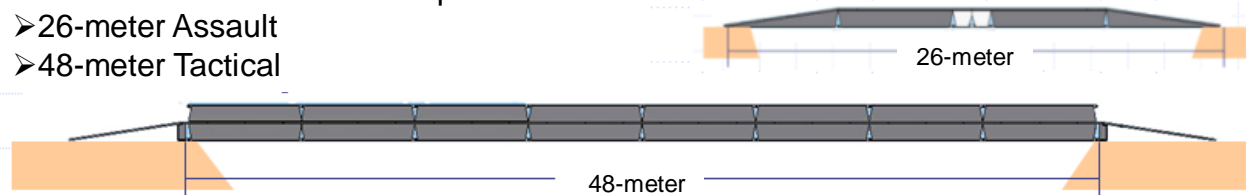


## Basic Building Blocks

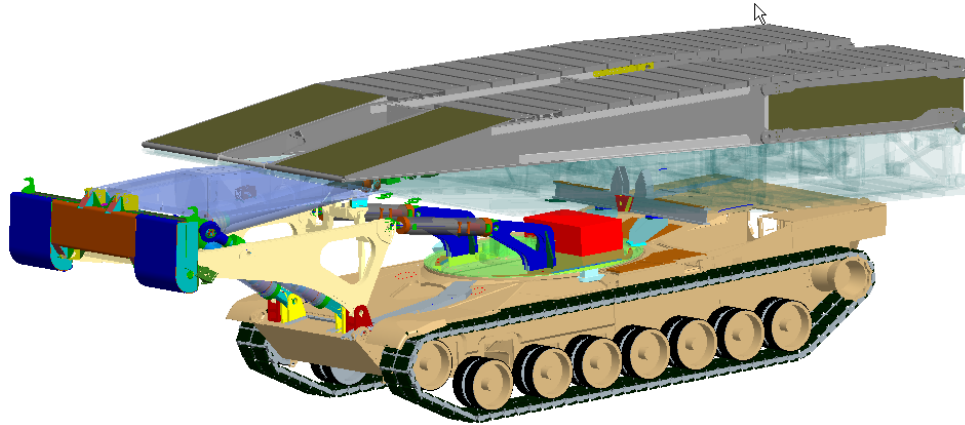


Assemble into MLC-100 T&W Concepts:

- 26-meter Assault
- 48-meter Tactical



Develop a prospective, single solution for Assault, Tactical and Line-of-Communication gap defeat that communicates in real-time its usage and safe load carrying classification.



Joint Program: Army, Marine Corps, and Navy

Development of 6.3 funded technology demonstration full scale composite JAB

## Requirements:

- MLC-100 Load Class at 18m (threshold), MLC-100 at full span (objective)
- span 24 Meters
- interface with JAB vehicle
- deploy/retrieve within 3 minutes (objective)
- allow for traffic of tracked and wheeled military vehicles



Leverage technology and lessons learned from UCSD Advanced Modular Composite Bridge

# Discussion